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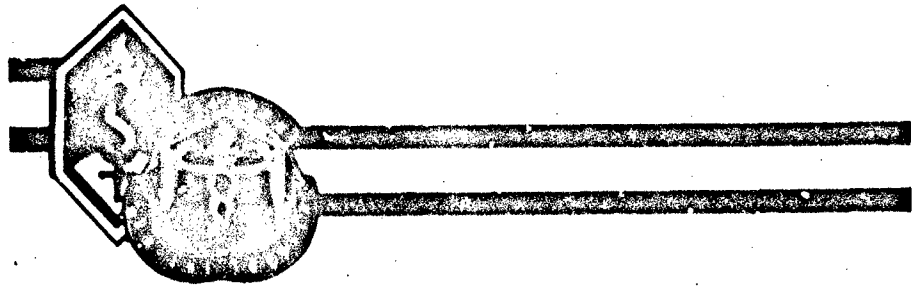

Test and Evaluation Report of the Airborne Life Support Systems Infant Transport Incubator, Model 20-H

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The Airborne Life Support Systems Infant Transport Incubator, Model 20-H, was tested for environmental and electromagnetic interference/compatibility in the UH-60A helicopter under the U.S. Army Program for Testing and Evaluation of Equipment for Aeromedical Operations. The tests were conducted using current military and industrial standards and procedures for environmental tests and electromagnetic interference/compatibility and human factors. The Airborne Life Support Systems Infant Transport Incubator, Model 20-H, was found to be compatible with the U.S. Army MEDEVAC UH-60 Black Hawk.

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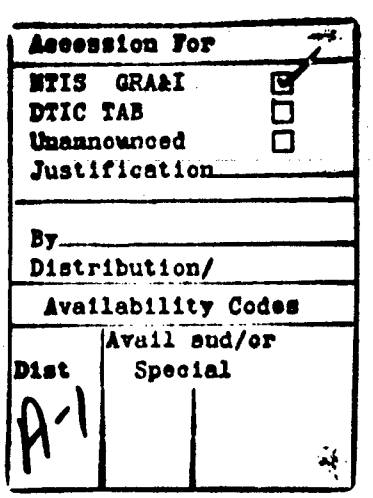

Section 1. Executive digest

The Army program for Test and Evaluation of Aeromedical Equipment uses existing military standards (MIL-STD) and collective professional expertise to test and evaluate selected medical equipment proposed for use aboard Army aircraft. Equipment meeting these standards ensures the safety of the crew, patients, and aircraft by eliminating risks due to: (1) Interference by the medical equipment with aircraft systems/subsystems operation, (2) the aircraft system's interference with the operation of the medical equipment, (3) the medical equipment's susceptibility to environmental exposure, or (4) physical and/or functional incompatibility while in use on board selected rotary-wing aircraft. This program tests both developmental and nondevelopmental (off the shelf) medical equipment destined for use aboard Army medical evacuation (MEDEVAC) aircraft.

1.1 TEST OBJECTIVES

1.1.1 To determine if the medical equipment is complete and operational per the manufacturer's operating instructions.

1.1.2 To ensure the electrical safety of the medical equipment.

1.1.3 To ensure the equipment will function as designed throughout the rated battery operation time.

1.1.4 To ensure the safety of the operator, the patient, and the aircrew.

1.1.5 To assess design considerations which could potentially contribute to an operator error.

1.1.6 To determine if the medical equipment can function as designed in a low pressure environment.

1.1.7 To determine the ability of the medical equipment to withstand the vibrational stresses expected in a rotary-wing flight environment without degradation or malfunction.

1.1.8 To determine the ability of the medical equipment to be stored and operated in a high temperature environment.

1.1.9 To determine the ability of the medical equipment to be stored and operated in a low temperature environment.

1.1.10 To determine the ability of the medical equipment to operate satisfactorily for short periods during exposure to high humidity conditions.

1.1.11 To assess the levels of electromagnetic emissions produced by the medical equipment within selected frequency ranges.

1.1.12 To assess the minimum electromagnetic susceptibility levels of the medical equipment within selected frequency ranges.

1.1.13 To assess the physical and/or functional compatibility of the medical equipment while in use on board the aircraft.

1.1.14 To assess the electromagnetic interference (EMI) and electromagnetic compatibility (EMC) characteristics of the medical equipment with the host aircraft and its installed systems.

1.2 TESTING AUTHORITY

Research and Technology Work Unit Summary, dated 5 October 1989. Project number 3M463807D836, titled, Army Program for Testing and Evaluation of Equipment for Aeromedical Operations.

1.3 SCOPE

1.3.1 This test was conducted at the United States Army Aeromedical Research Laboratory (USAARL), Cairns Army Airfield (CAAF), and designated test flight areas in and around Fort Rucker, Alabama.

1.3.2 The USAARL UH-60A aircraft, serial number 88-26069, with subsystems delineated in paragraph 3.2.2, was configured with the Airborne Life Support Systems Infant Transport Incubator* (ALSS), model 20-H and used as the test aircraft for the in-flight evaluation. The in-flight evaluation required 3.0 flight hours.

1.3.3 Laboratory testing was accomplished at USAARL using government furnished equipment (GFE) by Universal Energy Systems, Inc. (UES), under contract No. DAMD 17-86-C-6215.

1.3.4 Prior to flight testing, the following tests were accomplished: Acceptance inspection, equipment training, electromagnetic compatibility, human factors and safety, environmental compatibility, and in-flight compatibility.

1.3.5 An airworthiness release (AWR) dated 24 Feb 1992 was received from the U.S. Army Aviation Systems Command (AVSCOM) prior to the in-flight testing of the ALSS Transport Incubator.

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* See list of manufacturers

1.4 MATERIAL DESCRIPTION

The Airborne Life Support Systems Transport Incubator 20-H is an incubator system designed to maintain a stable thermal environment for infants during intensive care and transport applications. The transport incubator is one of six subcomponents which make up the incubator system. The incubator may be operated from externally supplied 12 volts dc and 105-125 volts ac, 50/60 Hz power sources. An internal, 12 volts dc, 24 amp-hour rechargeable sealed lead acid battery provides a rated 3 hours operation on a fully charged battery.

The incubator is mounted on a modular cart with four swivel mounted rubber wheels. Wheel locks are installed on the two front wheels. The cart frame is constructed of aluminum and has provisions for mounting and securing two size "M-60" oxygen cylinders.

The lower module of the incubator (77.7 x 95.3 x 48.8 cm) is secured to the cart by four metal latches located on the ends of the module. The lower module houses the accessory power supply. The accessory power supply is rated at 105-125 Vac, 3 A with a 3-amp circuit breaker and four accessory power outlets. The remainder of the lower module houses various system accessories.

The upper module consists of the incubator, the incubator control panel, and the incubator power supply. The remainder of the upper module can house additional system accessories. Two handles are mounted at each end of the upper module to maneuver the incubator. The upper module is secured to the lower module by four metal latches located on the ends of the upper module.

The incubator has a removable double canopy plexiglass hood which covers the infant compartment (71.12 cm l x 38.1 cm w x 27.94 cm h). The front of the canopy consists of two 13.97 cm diameter hinged circular doors mounted to a larger 22.9 cm x 53.34 cm hinged rectangular door to allow access to the infant from the side. The canopy is secured by four lock pins located on the side corners. Three sealed tubing portals 3.8 cm in diameter are also located on the canopy front. A fourth hinged trapezoidal access door is located on the left side panel of the canopy to allow access to the infant's head and shoulders. A five watt examination light is mounted outside the canopy on a flexible extension arm. The incubator is equipped with a removable infant support platform that is secured to the unit by flip type latches. The support platform includes a vinyl mattress pad for infant comfort and protection.

The incubator control panel is located on the center front of the incubator cart. The panel controls power to the system, by a labeled on/off toggle switch. Four green LED readouts on

the right side of the panel indicate the power source used by the system. The four lights are labeled BAT CHG, ac OP, dc OP, BAT OP. A red LED below these lights is labeled LOW BAT and provides a low battery warning. On the left hand side of the panel is a series of four alarm indicators and a power fail warning indicator. The four alarm LEDs are labeled HIGH TEMP, SYS FAIL, AIR FLO, and SENS FAIL. The temperature within the canopy is controlled by a microprocessor and a solid state heater. The temperature is selected by a series of thumb wheel switches on temperature control panel centered between the two rows of LEDs. Below the thumbwheel selector switches is a red digital LED readout of the temperature within the canopy calibrated to degrees Celsius. The control panel has provisions for a skin temperature probe and a momentary push button to show infant skin temperature on the digital display. The control panel performs a built-in test cycle when power is applied to the unit. During the test all LEDs will illuminate, the digital display will show 88.8 and the alarm will sound. The test lasts approximately 2.5 seconds and the unit begins normal operation upon completion of the test.

The incubator power supply unit has provisions for 105-125 Vac, 3 A and 12 VDC, 10 A power input connections. The unit has six 105-125 Vac accessory power outlets with the combined current drain for the six outlets rated at 3 A. The power supply has four circuit breakers, a 10 A battery, a 10 A external dc, a 3 A incubator, and a 3 A accessory outlet.

1.5 SUMMARY

1.5.1 Initial Inspection

1.5.2 Battery Life Evaluation: The manufacturer specifies a battery life up to 3 hours on a fully charged battery. Three tests were conducted using a fully charged battery for each trial. The average operation time in testing was 4 hours, 51 minutes at room temperature (25 °C and 55% RH). The results exceed the manufacturer specification.

1.5.3 Electrical Safety Evaluation: Grounding conductor resistance was 57.8 mΩ. Maximum case leakage current was 3.5 microamperes. These measurements are within the standards specified in TB-38-750-2, April 1987.

1.5.4 Human Factors Evaluation: The ALSS Transport Incubator 20-H was found to be satisfactory in all categories of the evaluation.

1.5.5 Environmental Tests: The ALSS 20-H can be expected to perform in a variety of environmental conditions. Its performance was found to be satisfactory in all stages of the

environmental testing except the high temperature and low temperature operation tests. When placed in a high temperature, the high temperature alarm did not activate. This indicated the high temperature alarm limit on this unit was not calibrated correctly at 100°F. The unit was not able to maintain 90°F inside the incubator when the ambient temperature was 32°F. The incubator temperature dropped to 73°F. The requirements for environmental tests are established in MIL-STD-810D, Methods 500.2 (altitude), 514.3 (vibration), 501.2 (high temperature), 502.2 (low temperature), and 507.2 (humidity).

1.5.6 Altitude (low pressure) Test: The ALSS Transport Incubator 20-H was found to be satisfactory in all categories of the evaluation.

1.5.7 Vibration Test: The ALSS 20-H Incubator was not adversely affected before, during or after exposer to the vibration test signature.

1.5.8 High Temperature Test: One failure was noted during testing. The temperature control for the Incubator was not able to regulate the temperature in the canopy (set to 31°C) during exposure to the high temperatures reached during the test (49°C). There are no provisions to cool the air inside the canopy, therefore the unit is unable to maintain canopy temperatures below ambient. During the test the system correctly responded with an overtemperature alarm condition.

1.5.9 Low Temperature Test: One failure occurred during testing. The Incubator was unable to maintain the canopy temperature set at 31°C while the system was operating on battery power and the chamber temperature was 0°C. The system was able to maintain canopy temperature using ac power.

1.5.10 Humidity Test: The ALSS Transport Incubator 20-H was found to be satisfactory in all categories of the evaluation.

1.5.11 Electro Magnetic Characteristics Test:

1.5.11.1 Conducted Emissions Test (CE01, CE02, and CE04): The unit produced narrowband (NB) emissions while operating on external dc power. The system failures are listed below in tabular format. No emissions that exceeded limits were detected from the ALSS Transport Incubator during this test while the unit was operated on ac or battery power.

EXTERNAL DC OPERATION: Conducted Emissions Failures

Frequency	Failure Levels
30 - 78 Hz	exceeded system measurement capability of dB
8.7 - 50 kHz	0.1 - 36.3 dB (NB)
5.78 - 50 kHz	0.1 - 35.6 dB (NB)

1.5.11.1.1 Conducted Susceptibility Test (CS02): The incubator was not susceptible to conducted radio frequency interference test levels.

1.5.11.1.2 Conducted Susceptibility Test (CS06): No susceptibility to the test power line spikes was noted in the ALSS Incubator.

1.5.11.2 Radiated Emissions Tests (RE02): The ALSS 20-H had no emissions exceeding specification limits of MIL-STD-461, Notice 4. The Incubator was returned to the manufacturer once during testing for the repair of internal damage which occurred while switching between ac and dc power modes.

1.5.11.3 Radiated Susceptibility Test (RS03): The ALSS 20-H was not found to be susceptible to the following radiated test signals. Failures manifested themselves in erratic displays, erroneous temperature measurements, and unwarranted alarm activations. The incubator experienced total system failures in the 30-200 MHz range in which it would not operate in any power supply mode. On each occasion, the incubator was returned to the manufacturer for repair. After the incubator was repaired, testing was resumed from the point of failure. The entire radiated susceptibility test was repeated after the last repair to verify the test results. The manufacturer had made modifications to the incubator that prevented total system failure during the repeated test runs.

Radiated Susceptibility (RS03) Failures

Frequency MHz	Field Strength (V/m)
AC OPERATION:	
30.0 - 60.6	2.11 - 5.96
81.0 - 149.0	1.58 - 7.08
166.0 - 189.8	1.00 - 8.41
DC OPERATION:	
7.6 - 7.7	0.33 - 0.84
30.0 - 115.0	1.78 - 6.31
138.8 - 149.0	1.78 - 4.73
176.2	3.35
204.0	4.22
BATTERY OPERATION:	
30.0 - 47.0	2.24 - 7.5
67.4 - 115.0	1.41 - 8.41
138.8 - 145.6	2.51 - 4.73
179.6 - 204.0	2.51 - 7.08

1.5.12 In-Flight Human Factors Evaluation: During the in-flight human factors evaluation, the ALSS 20-H was found to be satisfactory in all categories of the evaluation criteria.

1.5.13 In-Flight EMI/EMC Characteristics:

1.5.13.1 EMI: The aircraft and its subsystems were not adversely affected by the operation of the ALSS 20-H in any of the prescribed flight test modes.

1.5.13.2 EMC: The ALSS 20-H was not affected by the aircraft and its subsystems during the in-flight testing.

1.6 CONCLUSIONS

Based on the results of laboratory and in-flight testing, the Airborne Life Support Systems Infant Transport Incubator, Model 20-H was found to be compatible with U.S. Army MEDEVAC UH-60A Black Hawk with the subsystems listed in paragraph 3.2.2.

Section 2. Subtests

2.1 INITIAL INSPECTION

2.1.1 Objective

To determine if the Airborne Life Support System 20-H is complete and operational for testing per the manufacturer's operating instructions.

2.1.2 Criteria

2.1.2.1 The physical inventory is conducted solely for investigation and documentation.

2.1.2.2 The ALSS 20-H will display consistent and accurate performance as an acceptable standard.

2.1.3 Test procedure

2.1.3.1 A physical inventory of the ALSS 20-H was completed per the manufacturer's equipment list.

2.1.3.2 An operational validation test of the ALSS 20-H was conducted per the manufacturer's operating instructions by USAARL's medical maintenance personnel.

2.1.4 Test findings

2.1.4.1 The ALSS 20-H was inventoried and found to be complete.

2.1.4.2 The ALSS 20-H operated as prescribed in the manufacturer's operating manual. Criteria met.

2.2 BATTERY LIFE EVALUATION (Laboratory)

2.2.1 Objective

To ensure the equipment will function as designed throughout the rated battery operation time.

2.2.2 Criterion

2.2.2.1 The ALSS 20-H will perform consistently and accurately as an acceptable standard.

2.2.2.2 Verify manufacturer's specified full power internal battery life expectancy of 3 hours operation under specified mode

of a prewarmed infant chamber set at 37°C, with inspection light off.

2.2.3 Test procedure

2.2.3.1 Charging and operation cycles were conducted in ambient room conditions.

2.2.4 Test findings

The battery exceeded the manufacturer's 3-hour life expectancy in all tests. The average operating time recorded in testing was 4 hours, 51 minutes.

2.3 ELECTRICAL SAFETY EVALUATION

2.3.1 Objective

To ensure the electrical safety, by evaluation of case-to-ground resistance and case-to-ground current leakage, of the ALSS 20-H.

2.3.2 Criterion

The ALSS 20-H shall meet the standards established in TB-38-750-2 and NFPA 99 for electrical safety of medical equipment.

2.3.3 Test procedure

Evaluation of the electrical safety was conducted using a Neurodyne-Dempsey model 431F electrical safety analyzer*, IAW the procedures described in Technical Bulletin (TB) Number 38-750-2. Case-to-ground resistance and various case-to-ground leakage currents were measured. Checks were made for safety concerns such as case integrity, breaks in power cord insulation, and connectors.

2.3.4 Test findings

Grounding conductor resistance was 57.8 mΩ and maximum case leakage current was 3.5 μA. These measurements are within the limits specified in TB-38-750-2 and NFPA 99. Criterion met.

2.4 HUMAN FACTORS EVALUATION (Laboratory)

2.4.1 Objectives

2.4.1.1 To assure the safety of the operator, the potential patient, and the aircrew.

2.4.1.2 To assess the design considerations which could potentially contribute to an operator error.

2.4.2 Criterion

The ALSS 20-H must be rated satisfactory in all major categories of the evaluation. These include visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.4.3 Test procedure

2.4.3.1 The evaluation was conducted in a laboratory under fluorescent lighting and ambient room conditions.

2.4.3.2 The ALSS 20-H was operated according to prescribed instructions through its full range of functions.

2.4.4 Test finding

The incubator was satisfactory in all evaluation criteria. Criterion met.

2.5 ALTITUDE (LOW PRESSURE) TEST [IAW MIL-STD-810D, METHOD 500.2]

2.5.1 Objective

To determine if the ALSS 20-H can function as designed in a low pressure environment.

2.5.2 Criterion

2.5.2.1 The ALSS 20-H will display consistent and accurate performance as an acceptable standard.

2.5.2.2 The ALSS 20-H will perform as designed while exposed to an altitude equivalency of 15,000 feet above sea level.

2.5.3 Test procedure

2.5.3.1 A pretest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.5.3.2 The altitude test was performed in a Tenney Engineering model 64S altitude chamber*. This test is based on MIL-STD-810D, Method 500.2. The ALSS 20-H was operated on the floor of the chamber. Chamber pressure was decreased to 420 mmHg (15,000 ft equivalent altitude) over a 15-minute period, held constant for 60 minutes, then raised, at 1500 fpm, to ambient conditions (760

mmHg) over a 10-minute period. There are no provisions for the control of temperature or humidity inside this chamber.

2.5.3.3 A posttest performance check was conducted to ensure proper operation of the ALSS 20-H after the exposure to low pressure.

2.5.4 Test findings

2.5.4.1 The ALSS Transport Incubator met pretest performance criterion 2.5.2.1.

2.5.4.2 The ALSS Transport Incubator 20-H met altitude performance test criteria 2.5.2.1 and 2.5.2.2.

2.5.4.3 The ALSS Incubator 20-H met posttest performance check criterion 2.5.2.1.

2.6 VIBRATION TEST [IAW MIL-STD-810D, METHOD 514.3]

2.6.1 Objective

To determine the ability of the ALSS 20-H to withstand the vibrational stresses expected in a rotary-wing environment without degradation or malfunction.

2.6.2 Criteria

2.6.2.1 The ALSS 20-H will perform consistently and accurately as an acceptable standard.

2.6.2.2 The ALSS 20-H will remain operational and be able to perform consistently and accurately while exposed to vibrational stresses.

2.6.3 Test procedure

2.6.3.1 A pretest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.6.3.2 The vibration test was performed using an Unholtz-Dickey model TA115-40/CSTA vibration test system*. It is a single-axis system with an electromagnetic driver unit. The test consisted of sinusoidal vibrations superimposed on random vibrations over a frequency range of 500 Hz, as shown below. These vibrations are derived from performance taken on the floor under the copilot's seat in a UH-1 helicopter traveling at 120 knots. The reference spectrum breakpoints are from MIL-STD-810D, Method 514.3; reference spectrum levels are based on field performance with a conservatism factor of 1.5. Independent tests were conducted in the X, Y, and Z axes.

Z-axis

duration: 60 minutes
broadband intensity: 0.4506 G_{rms}
random vibration: initial slope : 99.00 dB/oct
5 Hz level: 0.00006210 $G_{sqr/Hz}$
100 Hz level: 0.0006210 $G_{sqr/Hz}$
300 Hz level: 0.0006210 $G_{sqr/Hz}$
500 Hz level: 0.00006210 $G_{sqr/Hz}$
final slope: -99.00 dB/oct
sinusoidal vibration: .5450 G_{pk} at 11.25 Hz
.1690 G_{pk} at 22.50 Hz
.1200 G_{pk} at 33.75 Hz
.0310 G_{pk} at 45.00 Hz
.0530 G_{pk} at 56.25 Hz

X and Y axes

duration: 60 minutes each
broadband intensity: 0.3099 G_{rms}
random vibration: initial slope: 99.00 dB/oct
5 Hz level: 0.00002920 $G_{sqr/Hz}$
100 Hz level: 0.0002920 $G_{sqr/Hz}$
300 Hz level: 0.0002920 $G_{sqr/Hz}$
500 Hz level: 0.00002920 $G_{sqr/Hz}$
final slope: -99.00 dB/oct
sinusoidal vibration: .3200 G_{pk} at 11.25 Hz
.0670 G_{pk} at 22.50 Hz
.0950 G_{pk} at 33.75 Hz
.0350 G_{pk} at 45.00 Hz
.0770 G_{pk} at 56.25 Hz

The ALSS 20-H was strapped to the vibration table fixture, and its performance was evaluated before, during, and after exposure to vibration.

2.6.3.3 A posttest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.6.4 Test findings

2.6.4.1 The pretest performance check met criterion 2.6.2.1.

2.6.4.2 The vibration test met criterion 2.6.2.2.

2.6.4.3 The posttest performance check met criterion 2.6.2.1.

2.7 HIGH TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 501.2]

2.7.1 Objective

To determine the ability of the ALSS 20-H to be stored and operated in a high temperature environment.

2.7.2 Criteria

2.7.2.1 The ALSS 20-H will perform consistently and accurately as an acceptable standard.

2.7.2.2 The ALSS 20-H will demonstrate consistent and accurate operation during the high temperature operation check.

2.7.2.3 The ALSS 20-H will demonstrate consistent and accurate operation after the high temperature storage cycle.

2.7.3 Test procedure

2.7.3.1 A pretest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.7.3.2 The high temperature test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test is based on MIL-STD-810D, Method 501.2. For the high temperature operation test, the ALSS 20-H was turned on and placed on the floor of the environmental chamber. The chamber temperature was raised to 49°C and the humidity was stabilized at a maximum of 20 percent relative humidity (RH) within 15 minutes. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. Temperature and humidity were held constant for 2 hours. At 30-minute intervals, the chamber door was opened briefly to minimize the change in chamber conditions during performance checks. After the operational test, the ALSS 20-H was allowed to return to ambient conditions over a 30-minute period.

2.7.3.3 A posttest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.7.3.4 The ALSS 20-H was stored (not operated) at temperatures of 63°C for 1 hour, 71°C for 4 hours, then again at 63°C for 1 hour. The chamber and ALSS 20-H then were returned to ambient conditions over a 30-minute period.

2.7.3.5 A poststorage performance check was conducted to ensure proper performance of the ALSS 20-H.

2.7.4 Test findings

2.7.4.1 The pretest performance check met criterion 2.7.2.1.

2.7.4.2 Temperatures within the canopy exceeded the 31°C set on the incubator control panel. Since the incubator has no provisions for air cooling within the canopy it can not regulate temperatures below ambient. The system responded correctly within its capabilities by failing with an alarm condition. Criteria 2.7.2.2 partially met.

2.7.4.3 The posttest performance check met criterion 2.7.2.1.

2.7.4.4 The ALSS 20-H functioned properly after the high temperature storage test. Criterion 2.7.2.3 met.

2.8 LOW TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 502.2]

2.8.1 Objective

To determine the ability of the ALSS 20-H to be stored and operated in a low temperature environment.

2.8.2 Criteria

2.8.2.1 The ALSS 20-H will perform consistently and accurately as an acceptable standard.

2.8.2.2 The ALSS 20-H will demonstrate consistent and accurate operation during the low temperature operation check.

2.8.2.3 The ALSS 20-H will demonstrate consistent and accurate operation after the low temperature storage cycle.

2.8.3 Test procedure

2.8.3.1 A pretest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.8.3.2 The ALSS 20-H was placed on the floor of the environmental chamber and the temperature was lowered to 0°C within 25 minutes. The environmental control system is capable of regulating temperature within 2°C. Humidity cannot be controlled in the chamber at freezing temperatures. The temperature was held constant for 2 hours. The chamber door was opened briefly every 30 minutes to minimize the change in chamber conditions, and a performance check was conducted. The chamber temperature then was raised to ambient temperature within a 30-minute period.

2.8.3.3 A posttest performance check was conducted to ensure proper operation of the ALSS 20-H.

2.8.3.4 The ALSS 20-H was "stored" in a nonoperational mode. The ALSS 20-H was placed on the floor of the environmental test chamber and the temperature was lowered to -46°C for 6 hours. The chamber then was raised to ambient temperature over a 30-minute period.

2.8.3.5 A poststorage performance check was conducted to ensure proper operation of the ALSS 20-H.

2.8.4 Test findings

2.8.4.1 The pretest performance check met criterion 2.8.2.1.

2.8.4.2 One failure was noted during testing. The incubator was not able to maintain the canopy temperature at the set level of 31°C while the system was operating on battery power and the chamber temperature was 0°C. The system performed normally during ac and external dc power operation. Criterion 2.8.2.2 partially met.

2.8.4.3 The posttest performance check met criterion 2.8.2.1.

2.8.4.4 The ALSS 20-H functioned properly after the low temperature storage test. Criterion 2.8.2.3 met.

2.9 HUMIDITY TEST [IAW MIL-STD-810D, METHOD 507.2]

2.9.1 Objective

To determine the ability of the ALSS 20-H to operate satisfactorily for short periods of time during exposure to highly humid conditions.

2.9.2 Criterion

2.9.2.1 The ALSS 20-H will perform consistently and accurately as an acceptable standard.

2.9.2.2 The ALSS 20-H will demonstrate consistent and accurate operation while exposed to a high humidity environment.

2.9.3 Test procedure

2.9.3.1 A pretest performance check was conducted to ensure the proper operation of the ALSS 20-H.

2.9.3.2 The humidity test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test is based on MIL-STD-810D, Method 507.2. For the humidity test, the ALSS 20-H was placed in operation on the floor of the environmental chamber. The chamber temperature was raised to a

temperature of 30°C and a relative humidity of 95 percent within 25 minutes. Temperature and relative humidity were maintained for 4 hours. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. At 45-minute intervals the performance of the ALSS 20-H was checked. The chamber door was opened briefly to minimize the change in chamber conditions. The chamber and the ALSS 20-H were returned to ambient conditions before the posttest performance validation check was conducted.

2.9.3.3 A posttest performance check was conducted to ensure the proper operation of the ALSS 20-H.

2.9.4 Test findings

2.9.4.1 The pretest performance check met criterion 2.9.2.1.

2.9.4.2 No failures were noted in the ALSS 20-H performance checks conducted during the exposure to the high humidity environment. Criterion 2.9.2.2 met.

2.9.4.3 The posttest performance check met criterion 2.9.2.1.

2.10 ELECTROMAGNETIC CHARACTERISTICS TEST [IAW MIL-STD-461A, Notice 4, AND MIL-STD-462, Notice 3]

2.10.1 Objectives

2.10.1.1 Conducted Emissions:

2.10.1.1.1 To assess the maximum levels of conducted electromagnetic emissions produced by the ALSS 20-H dc power leads in the 30 Hz-50 kHz frequency range. Method CE01.

2.10.1.1.2 To assess the maximum levels of conducted electromagnetic emissions produced by the ALSS 20-H ac power leads in the 10 kHz to 50 MHz frequency ranges. Method CE02.

2.10.1.1.3 To assess the maximum levels of conducted electromagnetic emissions produced by the ALSS 20-H power leads in the 50 kHz to 50 MHz frequency ranges. Method CE04.

2.10.1.2 Conducted Susceptibility:

2.10.1.2.1 To assess the tolerances of conducted susceptibility of the ALSS 20-H ac and dc power leads within the range of 50 kHz to 400 MHz. Method CS02.

2.10.1.2.2 To assess the tolerances of conducted susceptibility of the ALSS 20-H ac and dc power leads to transient pulse signals. Method CS06.

2.10.1.3 Radiated Emissions:

2.10.1.3.1 To assess the maximum levels of radiated electromagnetic emissions produced by the ALSS 20-H in the 14 kHz to 12.4 GHz Narrowband frequency range. Method RE02.

2.10.1.3.2 To assess the maximum levels of radiated electromagnetic emissions produced by the ALSS 20-H in the 14 kHz to 1 GHz Broadband frequency range. Method RE02.1.

2.10.1.4 Radiated Susceptibility:

2.10.1.4.1 To assess the tolerances of radiated electromagnetic susceptibility of the ALSS 20-H within the 10 kHz to 10 GHz electric field. Method RS03.

2.10.2 Criteria

2.10.2.1 Conducted Emissions: The ALSS 20-H will not conduct emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraphs 6.1 and 6.2.

2.10.2.2 Conducted Susceptibility: The ALSS 20-H will not malfunction when it is subjected to conducted emissions as specified in MIL-STD-461A, Notice 4, paragraphs 6.7 and 6.10.

2.10.2.3 Radiated Emissions: The ALSS 20-H will not produce emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraph 6.13.

2.10.2.4 Radiated Susceptibility: The ALSS 20-H will not malfunction when it is subjected to radiated emissions as specified in MIL-STD-461A, Notice 4, paragraph 6.20.

2.10.3 Test procedure

2.10.3.1-3 The conducted emissions tests were performed according to MIL-STD-462, Notice 3, Methods CE01,CE02 and CE04. The ALSS 20-H was placed on a grounded, copper-covered workbench. The top of the workbench was 1 meter from floor level, 1.37 meters long and 0.81 meters wide. Power was supplied via a pair of line impedance stabilization networks (LISN) and a test jig. The test jig is a wooden tray with two power receptacles and two slots to hold current probes in place around power supply conductors. While the ALSS 20-H was operating, the frequency range (10 kHz to 50 MHz) was scanned for emissions conducted in the power cable from the Incubator.

2.10.3.4 The conducted susceptibility test was performed according to MIL-STD-462, Notice 3, Method CS02. The ALSS 20-H was placed on a grounded, copper-covered workbench. Radio frequency interference was induced on the power leads and measured at the incubator power cable. Tests were conducted using both ac and dc external power supply inputs. The frequency of the interference was incremented over the 50 kHz to 400 MHz range while the unit was operated. The unit was observed visually for proper operation while it was subjected to the radio interference on the power leads. Each frequency was held for 15 seconds.

2.10.3.5 The conducted susceptibility spike test was performed on a chemical resistant counter top according to MIL-STD-462, Notice 3, Method CS06. Power was supplied via a customized metal connection box. The connection box has two power receptacles and four banana jacks on its front panel. Connections to the individual power lines were made in series through the banana jacks. In the ac power test transient spikes of 100 V, 10 microseconds were generated with a Solar Electronics model 8282-1 transient pulse generator* and induced onto the power leads at the connection box banana jacks. In the external dc power test transient spikes of 26 V, 10 microseconds were generated as above and induced into the dc power leads at the connection box banana

jacks. All spikes were monitored with a Tektronix 2235 oscilloscope* connected to a power receptacle on the connection box. The ALSS 20-H was plugged into the other receptacle on the connection box and placed in operation. The incubator was observed for correct operation while it was subjected to the power line spikes.

2.10.3.6 The radiated emissions test was performed according to MIL-STD-462, Notice 3, Method RE02. The ALSS 20-H was positioned on a wooden test stand inside the EMI chamber, 1 meter away from the receiving antennas. The antennas were mounted for both vertical and horizontal polarities and connected to EMI receivers. While the ALSS 20-H was operating, the frequency spectrum (14 kHz to 12.4 GHz) was scanned for emissions. The ALSS 20-H was operated in ac, external dc and battery power modes.

2.10.3.7 The radiated susceptibility test was performed according to MIL-STD-462, Notice 3, Method RS03. The ALSS 20-H was positioned on a wooden test stand inside the EMI chamber 1 meter away from the transmitting antennas. The antennas were mounted for both vertical and horizontal polarities and connected to radio frequency (RF) transmitters. While the ALSS 20-H was operating, it was monitored for faulty operation during exposures to fields of 1 V/m from 10 kHz to 2 MHz, and 5 V/m from 2 to 30 MHz, 10 V/m from 30 MHz to 2 GHz, and 5 V/m from 2 to 10 GHz. All RF carrier waves were 50 percent amplitude modulated with a 1000Hz tone. The unit was monitored for correct operation during the exposure period by use of a video camera and monitor. Tests were conducted with the unit operating on ac, external dc, and battery power.

2.10.4 Test findings

2.10.4.1 During the radiated emissions test, no emissions which exceeded specification limits of MIL-STD-461A, Notice 4, were detected. The unit was returned to the manufacturer once during the testing for the repair of internal damage which occurred while switching between ac and dc operating power modes.

2.10.4.2 The ALSS 20-H was found to be susceptible to radio frequency interference in the following frequencies and field strengths.

Radiated Susceptibility (RS03) Failures:

Frequency MHz	Field Strength (V/m)
AC OPERATION:	
30.0 - 60.6	2.11 - 5.96
81.0 - 149.0	1.58 - 7.08
166.0 - 189.8	1.00 - 8.41

Frequency MHz			Field strength (V/m)		
DC OPERATION:					
7.6	-	7.7	0.33	-	0.84
30.0	-	115.0	1.78	-	6.31
138.8	-	149.0	1.78	-	4.73
176.2			3.35		
204.0			4.22		
BATTERY OPERATION:					
30.0	-	47.0	2.24	-	7.5
67.4	-	115.0	1.41	-	8.41
138.8	-	145.6	2.51	-	4.73
179.6	-	204.0	2.51	-	7.08

2.10.4.3 Signal failures were detected from the ALSS 20-H during the conducted emissions test. Criterion partially met.

2.10.4.4 The ALSS 20-H was not susceptible to radio frequency interference (RFI) or test spikes during the conducted susceptibility tests. Criterion met.

2.11 IN-FLIGHT HUMAN FACTORS EVALUATION

2.11.1 Objective

To assess the physical and/or functional compatibility of the ALSS 20-H while in use onboard the aircraft.

2.11.2 Criterion

The flight surgeon will be able to operate the ALSS 20-H without physical or functional restrictions aboard the aircraft. Major areas of concern include: Proper operation, visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.11.3 Test procedure

2.11.3.1 A human factors evaluation was performed IAW MIL-STD-1472D, AAMI Human factors engineering guidelines, and UL-544 to ensure the compatibility of the ALSS 20-H and the in-flight environment. The flight surgeon conducted the test wearing a flight suit, flight gloves, and an SPH-4B flight helmet. An evaluation of the compatibility with the nuclear, biological, and chemical (NBC) protective equipment was not conducted. Due to

restrictions of the AWR, testing was conducted during daylight hours only.

2.11.3.2 The ALSS 20-H was placed on the floor of the aircraft and secured with cargo straps. The ALSS 20-H was tested using ac and battery power in all flight scenarios required by the In-flight Test Operations Procedures (ITOP) (refer to section 3.2).

2.11.4 Test findings

During the in-flight human factors evaluation, the ALSS 20-H was found to be satisfactory in all categories of the evaluation criteria. The battery provided 45 minutes operation with the light on and the internal temperature set to 90°F (58°F ambient). Battery power alone may not be sufficient for a long transport or cold climate. Criterion met.

2.12 IN-FLIGHT EMI/EMC CHARACTERISTICS

2.12.1 Objective

To assess the EMI/EMC characteristics of the ALSS 20-H with the host aircraft and its installed systems.

2.12.2 Criteria

2.12.2.1 The ALSS 20-H will not radiate EMI to disrupt or interfere with other equipment or systems aboard the aircraft.

2.12.2.2 The aircraft will not radiate EMI to disrupt or interfere with the ALSS 20-H's operation.

2.12.3 Test procedure

A qualitative EMI/EMC assessment was performed with both the ALSS 20-H and the aircraft operating as source and victim. The ALSS 20-H and applicable aircraft instruments and systems were monitored for unusual operation, readings, surges, or power anomalies for each checklist item (see pages 3-4 through 3-7).

2.12.4 Test findings

2.12.4.1 There were no adverse instances of EMI/EMC noted with the ALSS 20-H acting as either the source or victim. Criterion met.

2.12.4.2 There were no adverse instances of EMI/EMC noted with the aircraft acting as either the source or victim. Criterion met.

Section 3. Supporting documentation

3.1 DETAILED TEST INFORMATION

3.1.1 General information

3.1.1.1 ALSS 20-H testing is not considered a major action significantly affecting the quality of the human environment and, therefore, qualifies for categorical exclusion A-28, appendix A, AR 200-1.

3.1.1.2 A safety pilot will be designated for each flight. Flight operations will be conducted IAW the aircraft operator's manual, appropriate aircrew training manuals, and test item technical data.

3.1.2 Material description

3.1.2.1 The ALSS 20-H is an incubator system designed for intensive care isolation of infants during transportation on its mobile stand, in an ambulance, or in an aircraft. The incubator may be operated from 12 and 24 volts dc and 120 volts ac, 50-60 Hz power sources.

The incubator has a hinged plexiglass hood which covers the top and front of the infant compartment. A thermometer holder is located on the inside of the hood to measure internal temperature. Two 6-inch round access doors are located on the front of the hood to allow access to the infant from the side. A 6 x 9 inch access door is located at the end of the incubator to allow access to the infant's head and shoulders. The incubator is equipped with a support board and Velcro™ straps to secure the infant and an adjustable IV stand stored on the back of the incubator.

A heating coil warms the air in the incubator. The temperature is selected by a temperature adjustment dial. Indicator lamps are provided to display POWER or HEATER operation. When the safety limit temperature is exceeded, a HIGH TEMP light is illuminated. Humidity may be added to the heated air via a humidity chamber on the side of the unit. Water is added to a sponge in a drawer and heated air flowing past the sponge provides 40-60 percent humidity for 3-4 hours. Provision is made for a "D" or "E" size oxygen cylinder in the body of the incubator to provide a portable source of oxygen. Oxygen concentrations of 40-90 percent may be obtained using an accessory regulator and fresh air intake vane on the incubator.

3.1.2.2 Dimensions: 96.5 x 49.5 x 38.1 cm (38 x 19.5 x 15 in).

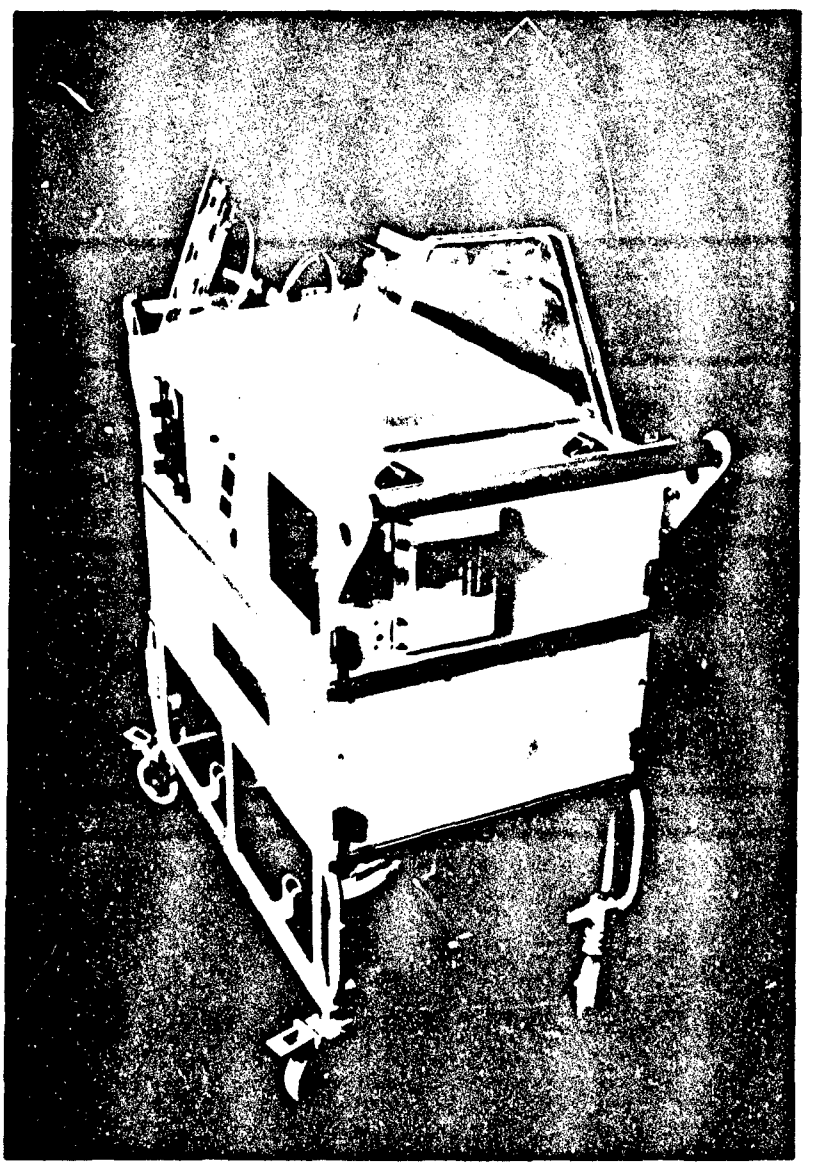
3.1.2.3 Weight: Incubator - 39.9 kg (88 lbs)
Transport cart - 16.8 kg (37 lbs)

3.1.2.4 Heating capacity: 12 or 24 Vdc - capable of maintaining 90°F in 35°F ambient; 120 Vac - capable of raising temperature 20°F above a 70°F ambient temperature in less than 20 minutes.

3.1.2.5 Power requirements: 120 Vac, 60 Hz, 2 amps; 240 Vac, 50 Hz, 1 amp; 12 Vdc, 14 amps; or 24 Vdc, 7 amps.

3.2 TEST DATA

3.2.1 Photographic description



3.2.2 Aircraft equipment list

Item No.	Nomenclature
1	Receiver radio -- R-1496A/ARN-89 (automatic direction finder)
2	Displacement gyro -- CN-1314/A
3	Gyro directional -- CN-998/ASN-43
4	Signal data converter -- CV-3338/ASN-128
5	Receiver -- R-2139/ARN-123 (VOR/LOC/MB/GS)
6	Command instrument system processor -- 70600-01038-101
7	SAS amplifier -- 70901-02908-104 (flight control stability augmentation system)
8	Rate gyro -- TRU-2A/A
9	Amplifier, impedance -- AM-4859A/ARN-89
10	Cargo hook -- FE-7590-145
11	Receiver, radar -- RT-1193/ASN-128 (doppler navigation receiver)
12	Barometric altimeter -- AAU-31/A-1
13	Barometric altimeter -- AAU-32A
14	Receiver/transmitter -- RT-1300/ARC-186 (VHF-AM and/or FM radio)
15	UHF-AM radio set -- RT-1518/ARC-164
16	Interphone control -- C6533/ARC (aircraft intercom control)
17	Receiver/transmitter -- RT-1115D/APN-209 (radar altimeter)
18	Indicator altimeter -- ID-1917C/APN-209 (radar altimeter)
19	Control radio set -- C-7392A/ARN-89 (automatic direction finder)
20	Comparator signal data -- CM-482/ARC-186 (comparator for ARC-186)
21	Receiver/transmitter -- RT-1296A/APX-100 (transponder with IFF)
22	Computer display unit -- CP-1252/ASN-128 (doppler navigation system)
23	Compass set controller -- C-8021E/ASN75
24	Magnetic compass - standby -- MS-17983-4

3.2.3 In-flight test data card

DATA CARD FORMAT

GUIDELINE FOR DATA COLLECTION

IN-FLIGHT SUITABILITY TEST OF MEDICAL ITEMS

1. Installation/removal.	Suitable Yes	Suitable No	Comments
a. Weight and balance (DD Form 365-4, Clearance Form F).	X		
b. Space/area allocation.			
(1) Operational requirements.	X		
(2) Storage requirements.	X		
c. Interface connections (safe, positive, secure).	X		
d. Installation/removal (expedient/easily achieved).	X		
e. Mounting/final configuration (functional/stable).	X		

2. Operations and performance.	Suitable Yes	Suitable No	Comments
a. Manufacturer's operating instruction.	X		
b. Medical item operation before aircraft run-up.	X		
c. System interface during aircraft engine run-up and medical item operation (EMI switchology checklist).	X		
(1) Aircraft voltage output.	X		

	Suitable Yes	Suitable No	Comments
(2) Flight control function (UH-60).	X		
(3) Stabilator function (UH-60).	X		
(4) Radio communication vs. medical item operation.			
(a) FM	X		
(b) UHF	X		
(c) VHF	X		
(5) Navigation equipment vs. medical item operation.			
(a) Transponder	X		
(b) ADF	X		
(c) VOR	X		
(d) Doppler	X		
(6) Radar altimeter operation vs. medical item operation.	X		
d. System interface during aircraft hover and medical item operation (EMI switchology checklist).			
(1) Voltage output.	NA		
(2) Radio communication vs. medical item operation.			
(a) FM	X		
(b) UHF	X		
(c) VHF	X		

	Suitable Yes	No	Comments
(3) Navigation equipment operation vs. medical item operation.			
(a) Transponder	X		
(b) ADF	X		
(c) VOR	X		
(d) Doppler	X		
e. Flight mission profile vs. medical item operation (EMI switchology checklist).			
(1) Straight and level (1000 ft MSL for 20 minutes).			
(a) Compatibility of flight mode and medical item operation.	X		
(b) Radio communication vs. medical item operation.			
a. FM	X		
b. UHF	X		
c. VHF	X		
(2) NOE (20 minutes). compatibility of flight mode and medical item operation.	X		
(3) FM homing (10 minutes).	X		
(4) Doppler navigation vs. medical item operation.			
(a) Initialize function.	X		
(b) Fix function.	X		
(c) Update function.	X		

	Suitable Yes	No	Comments
(5) VOR navigation 7000 ft MSL for 20 minutes) vs. medical item operation.	X		
(6) ILS approach vs. medical item operation.	X		
f. Medical item operation after engine shutdown (external power source).	X		
g. Restrictions to the medical item's use (i.e., electrical connectors).	X		
h. Deviations from the laboratory test results.			
(1) Electrical/ electronic.	None		
(2) Mechanical environment.	None		
(3) Human factors (user interface, controls, markings, lighting, egress).	None		
(4) Safety.	None		

3. Deviations from the in-flight test protocol.

a. The VOR navigation portion of the in-flight test conducted at 2000 feet MSL due to air traffic control clearance.

3.2.4 EMI switchology checklist

EMI SWITCHOLOGY CHECKLIST UH-60 AIRCRAFT

IN-FLIGHT SUITABILITY OF MEDICAL ITEMS

ENG INSTRUMENTS/CDU	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Fuel quantity	X			
Fuel indicator test	X			
XMSN oil temperature	X			
XMSN oil pressure	X			
#1 engine oil temperature	X			
#2 engine oil temperature	X			
#1 engine oil pressure	X			
#2 engine oil pressure	X			
#1 TGT	X			
#2 TGT	X			
#1 Ng speed	X			
#2 Ng speed	X			
CDU digits on/off	X			
CDU instruments dim	X			

ENG INSTRUMENTS/PLT PDU	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
#1 engine RPM	X			
#2 engine RPM	X			
Rotor RPM	X			
#1 torque	X			
#2 torque	X			

ENG INSTRUMENTS/COPLT PDU	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
#1 engine RPM	X			
#2 engine RPM	X			
Rotor RPM	X			
#1 torque	X			
#2 torque	X			

ENG CONTROLS	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
#1 overspeed	X			
#2 overspeed	X			
RPM switch	X			
#1 engine anti-ice	X			
#2 engine anti-ice	X			
#1 inlet anti-ice	X			
#2 inlet anti-ice	X			

RADIO EQUIPMENT	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
ICS, C-6533 ARC	X			
VHF-FM, ARC-186/115	X			
VHF-AM, ARC-186/115	X			
UHF-AM, ARC-164(V)	X			
Crypto, KY-28	Not installed			
Radio retransmissions PLN	Not installed			
Transponder, APX-100(V)	X			
KIT-1A/TSEC IFF computer	Not keyed with code			

MISSION EQUIPMENT	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
RWR, APR-39(V)	Not installed			
IR CM, ALQ-144	Not installed			
Chaff dispenser, M-130	Not installed			
Cargo hook system	X			

HYDRAULIC CONTROL SYSTEM	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Backup hydraulic pump	X			
Servo off 1st stage/PLT	X			
Servo off 2nd stage/PLT	X			
Servo off 1st stage/COPLT	X			
Servo off 2nd stage/COPLT	X			
Hydraulic leak test	X			
Tail servo	X			
Boost servos	X			

FUEL SYSTEM	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Fuel pump switch	X			
Fuel boost pump #1	X			
Fuel boost pump #2	X			
Fuel cont panel ESSS	X			

WARNING SYSTEM	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Low rotor RPM	X			
Master caution	X			
Caution advisory	X			
Fire warning	X			
AFCS	X			
Stabilator	X			
#1 engine out	X			
#2 engine out	X			

NAVIGATION INSTRUMENTS	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
ADF	X			
Magnetic compass	X			
CONUS NAV, ARN-123	X			
Doppler, ASN-128	X			
Gyro mag compass (PLT)	X			
Gyro mag compass (COPLT)	X			
Compass cont panel, ASN-75	X			
HSI	X			

FLIGHT INSTRUMENTS	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Radar altimeter	X			
Stabilator pos indicator	X			
VSI	X			
CIS mode select	X			
SAS 1	X			
SAS 2	X			
FPS	X			
Trim	X			
Go-around enable	X			
Cyclic trim release	X			
Cyclic stick trim	X			
ALR encoder	X			

FLIGHT INSTRUMENTS (CONT)	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
HSI/VSI mode select (PLT)				
DPLR	X			
VOR/ILS	X			
BACK CRS	X			
FM HOME	X			
TURN RATE	X			
CRS HDG	X			
VERT GYRO	X			
BRG 2	X			
HSI/VSI Mode Select (COPLT)				
DPLR	X			
VOR/ILS	X			
BACK CRS	X			
FM HOME	X			
TURN RATE	X			
CRS HDG	X			
VERT GYRO	X			
BRG 2	X			

MISCELLANEOUS EQUIPMENT	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Blade deice	Not tested			Ambient temperature was out of test limits.
Windshield anti-ice	X			
Pitot heat	X			
Vent blower	X			
Windshield wiper	X			
Heater	X			
APU	X			
Generator #1	X			
Generator #2	X			
Generator APU	X			
Air source heat start	X			
Tail wheel lock	X			
Gyro erect	X			

LIGHTING	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Cockpit utility	X			
Cockpit flood	X			
Cabin dome	X			
Search light	X			
Search light control	X			
Landing light	X			
Flt instr lights (PLT)	X			
Flt instr lights (COPLT)	X			
Nonflight instr lights	X			
Console lights, upper	X			
Console lights, lower	X			
Position lights	X			
Formation lights	X			
Anticollision lights	X			
NVG lighting	X			

3 2.5 Battery life evaluation

Battery Life Evaluation
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Manufacturer battery life specification: 3 hours.
Specified battery recharge time: 6 hours with the unit off.
Specified Mode of Operation under battery power: Prewarmed infant chamber set at 37°C, light off.

Overall performance: Pass.

Measurements:

Dates of First Test:	10/10/90
Temperature:	75°F
Humidity:	55% RH
Start Times:	0825
End Times:	1326
Operating Times:	5 hours 1 minute
PERFORMANCE:	Pass
Dates of Second Test:	10/11/90
Temperature:	74°F
Humidity:	55% RH
Start Times:	0828
End Times:	1326
Operating Times:	4 hours 58 minutes
PERFORMANCE:	Pass
Dates of Third Test:	10/12/90
Temperature:	75°F
Humidity:	55% RH
Start Times:	0844
End Times:	1338
Operating Times:	5 hours 55 minutes
PERFORMANCE:	Pass

Comments: None

3.2.6 Electrical safety test

Electrical Safety Test
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 08 Dec 89

Measurements:

Grounding conductor resistance (milliohms): 57.8

Leakage current - Case to ground (microamperes):

unit off, grounded, normal polarity	0.2
unit off, ungrounded, normal polarity	3.4
unit off, ungrounded, reverse polarity	3.5
unit on, grounded, normal polarity	0.2
unit on, ungrounded, normal polarity	3.4
unit on, ungrounded, reverse polarity	3.5

MAXIMUM LIMITS:

ground resistance (milliohms):	150
current (microamperes)	
current (grounded, type A unit):	10
current (ungrounded, type A unit):	100
current (grounded, type B unit):	50
current (ungrounded, type B unit):	500

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.7 Human factors evaluation

Human Factors Evaluation
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 09 Jan 90

Item configuration during test: Item prepared for operation.

Checklist for HFE

	RESULTS
VISUAL DISPLAYS:	Satisfactory
display type, format, content	
location of displays	
indicator lights	
scalar displays	
color coding	
legends and labels	
cathode ray tubes	
counters	
flags, go-no-go, center-null indicators	
Comments: None.	
CONTROLS:	Satisfactory
location	
characteristics of controls	
labeling	
control - display relationships	
Comments: None.	

TIME REQUIRED TO PREPARE FOR OPERATION (list in comment)

Comments: Approximately 1 hour and 15 minutes.

MAINTAINABILITY: Satisfactory

component location
component characteristics
rests and stands
covers, cases, access doors
handles
lubrication
component mounting
cord storage provisions
external accessibility
internal accessibility
list special tools required
list realistic inspection requirements
list realistic inspection intervals

Comments: None.

CONDUCTORS: Satisfactory

binding and securing
length
protection
routing
conductor coding
fabrication
connectors

Comments: None.

FASTENERS: Satisfactory

access through inspection panel covers
enclosure fasteners
device mounting bolts and fasteners

Comments: None.

TEST POINTS: Satisfactory

general
location and mounting
test point labeling and coding

Comments: None

TEST EQUIPMENT: Satisfactory

general
equipment self-test
indicators (list in comments)
controls
positive indication of proper operation

Comments: None

FUSES AND CIRCUIT BREAKERS: Satisfactory

external accessibility
easy replacement or reset by operator

Comments: None

LABELS AND CODING: Satisfactory

placed above controls and displays
near or on the items they identify
not obscured by other equipment components
describe the function of the items they identify
readable from normal operating distance
conspicuous placards adjacent to hazardous items

Comments: None

SAFETY: Satisfactory

manual
materials
fire and explosive protection
operator protection from mechanical hazards
patient protection from mechanical hazards
electrical safety (operator and patient)

Comments: The first unit tested had a different battery model than the one described in the manual and the power cord was damaged. This was repaired prior to use.

3.2.8 Altitude test

Altitude Test
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 28 Aug 91

Item configuration during test: Item sitting on chamber floor.

Performance test criteria: Accurate maintenance of selected temperature.

Ambient conditions outside chamber:

Temperature	70°F
Humidity	n/a
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	120 Vac
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None

IN-TEST DATA

Time of test start: 1335

POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Time of test end : 1450

Item functional (based on performance test criteria): Yes

Deviation from pretest : None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.9 Vibration test

Vibration Test
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 15 Dec 90

Item configuration during test: Item strapped down on vibration table fixture.

Performance test criteria: Accurate maintenance of selected temperature.

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	120 Vac
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None

Ambient conditions

Temperature	71°F
Humidity	61% RH
Barometric pressure	1 atm

IN-TEST DATA

Data and performance checks during test:

Time at first check:
X: 130940 Dec 89 Y: 121245 Dec 89 Z: 131220 Dec 89

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

Time at second check:
X: 131020 Dec 89 Y: 121325 Dec 89 Z: 131300 Dec 89

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

POSTTEST DATA

Time at test end:
X: 131030 Dec 89 Y: 121335 Dec 89 Z: 131310 Dec 89

Posttest performance check (complete check of item and accessories):

Item functional (based on performance test criteria): Yes

Item intact: Yes

Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: Test times for the three axes are on different days.

3.2.10 High temperature test

High Temperature Test
(Equipment Operating)
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 28 Dec 89

Item configuration during test: Unit was sitting on chamber floor, operating on ac power and battery power. Incubator set for 31°C.

Performance test criteria: Incubator maintains set temperature with no alarm conditions.

Ambient conditions outside chamber:

Temperature	78°F
Humidity	50% RH
Barometric pressure	766 mmHg

PRETEST DATA

Pretest performance check :
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	120 Vac
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None
distance from north wall (meters)	0.250
distance from south wall (meters)	0.410
distance from east wall (meters)	0.790
distance from west wall (meters)	1.750
distance from ceiling (meters)	1.000
distance from floor (meters)	0.000

IN-TEST DATA

Time of test start: 1130

Performance checks during test:

First check:

Time:	1230
Temperature:	49°C
Humidity:	15% RH
Barometric pressure:	766 mmHg
Item functional (based on performance test criteria):	Fail, High Temperature Alarm Condition
Deviation from pretest:	Controller was unable to regulate temperature as set at 31°C. Resulted in the unit shutting itself down and alarm indication.

Second check:

Time:	1230
Temperature:	49°C
Humidity:	15% RH
Barometric pressure:	766 mmHg
Item functional (based on performance test criteria):	Fail: High temperature alarm condition.
Deviation from pretest:	Controller unable to regulate temperature

Third check:

Time:	1300
Temperature:	49°C
Humidity:	15% RH
Barometric pressure:	766 mmHg
Item functional (based on performance test criteria):	Fail: High temperature alarm condition.
Deviation from pretest:	Controller unable to regulate temperature.

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end:	1330
Item functional (based on performance test criteria):	Yes, all ok
Deviation from pretest:	None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: High temperature alarm activated on all three tests. There are no provisions built in for canopy cooling.

3.2.11 High temperature storage test

High Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 2 Jan 90

Item configuration during test: Sitting on chamber floor, in storage, not operating.

Performance test criteria: Consistent and accurate maintenance of selected incubator temperature.

Ambient conditions outside chamber:

Temperature	24°C
Humidity	28% RH
Barometric pressure	768 mmHg

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	All
distance from north wall (meters)	0.25
distance from south wall (meters)	0.41
distance from east wall (meters)	0.79
distance from west wall (meters)	1.75
distance from ceiling (meters)	1.00
distance from floor (meters)	0.00

Time of test start:	0820
Midtest time:	1153
Midtest temperature:	71°C

Midtest Humidity: 15% RH

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1530
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks:
The unit was allowed to cool for 1 hour at ambient conditions before the posttest performance check was completed.

Comments on test run (including interruptions): None

Comments on other data: None

3.2.12 Low temperature test

Low Temperature Test
(Equipment Operating)
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 29 Dec 89

Item configuration during test: Sitting on chamber floor. Incubator set for 31°C.

Performance test criteria: Accurate maintenance of selected incubator temperature.

Ambient conditions outside chamber:

Temperature	23°C
Humidity	42% RH
Barometric pressure	767 mmHg

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Pass

Installation of item in test facility:

list connections to power	120 Vac
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External dc outlet
distance from north wall (meters)	0.25
distance from south wall (meters)	0.41
distance from east wall (meters)	0.79
distance from west wall (meters)	1.75
distance from ceiling (meters)	0.99
distance from floor (meters)	0.00

Time of test start: 0815

Performance checks during test:

First check:

Time: 0845
Temperature: 0°C
Humidity: 15% RH
Barometric pressure: 767 mmHg
Item functional (based on performance test criteria): Yes
Deviation from pretest: None.

Second check:

Time: 0915
Temperature: 0°C
Humidity: 15% RH
Barometric pressure: 767 mmHg
Item functional (based on performance test criteria): Yes
Deviation from pretest: None.

Third check:

Time: 0945
Temperature: 0°C
Humidity: 15% RH
Barometric pressure: 767 mmHg
Item functional (based on performance test criteria): Yes
Deviation from pretest: Incubator temperature is 26.7°C while the unit is on battery power. The temperature is maintained at 31°C while on ac power.

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1030
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None.

Comments on test run (including interruptions): Incubator temperature setting of 31°C was not maintained while the unit operated on battery power.

Comments on other data: None

3.2.13 Low temperature storage test

Low Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 3 Jan 90

Item configuration during test: Sitting on chamber floor, not operating, in storage.

Performance test criteria: Accurate maintenance of selected incubator temperature.

Ambient conditions outside chamber:

Temperature	24°C
Humidity	44% RH
Barometric pressure	768 mmHg

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None
distance from north wall (meters)	0.25
distance from south wall (meters)	0.41
distance from east wall (meters)	0.79
distance from west wall (meters)	1.175
distance from ceiling (meters)	1.00
distance from floor (meters)	0.00

Time of test start:	0850
Midtest time:	1230
Midtest temperature:	-46°C

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1600
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: The unit was allowed to return to ambient conditions overnight, due to condensation.

Comments on test run (including interruptions): None

Comments on other data: None

3.2.14 Humidity test

Humidity Test
Report Form

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: None

Options installed: None

Date of test: 29 Dec 89

Item configuration during test: The unit was sitting on the chamber floor, temperature set for 31°C.

Performance test criteria: Accurate maintenance of selected temperature.

Ambient conditions outside chamber:

Temperature	25°C
Humidity	58% RH
Barometric pressure	767 mmHg

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	120 Vac
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None
distance from north wall (meters)	0.25
distance from south wall (meters)	0.41
distance from east wall (meters)	0.79
distance from west wall (meters)	1.75
distance from ceiling (meters)	1.00
distance from floor (meters)	0.00

IN-TEST DATA

Time of test start: 1120

Performance checks during test:

First check:

Time:	1230
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	767 mmHg
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Second check:

Time:	1315
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	767 mmHg
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Third check:

Time:	1400
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	767 mmHg
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Fourth check:

Time:	1445
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	767 mmHg
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Fifth check:

Time:	1520
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	767 mmHg
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 1610
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.15 Electromagnetic characteristics test

****

Electromagnetic Characteristics Testing
Evaluation of Performance
****

T & E Item Number: 18 Date: 04 Jan 90

Nomenclature: Transport Incubator
Manufacturer: Airborne Life Support Systems
Model number: 20-H
Serial number: 188XB
Military item number: NA

****

Conducted Emissions Tests:

CE01 Testing configuration(s): Operating on copper bench.
Performance (pass/fail): Fail.

Comments: Failures from 30-78 Hz. Amount exceeded limits.

CE02 Testing configuration(s): Operating on copper work bench.
Performance (pass/fail): Pass
Comments: No signal failures.

CE04 Testing configuration(s): Operating on copper work bench.
Performance (pass/fail): Pass
Comments: No failure level emissions were detected.

Conducted Susceptibility Tests:

CS02 Testing configuration(s): Operating on copper test bench.
Performance (pass/fail): Pass
Comments: Not susceptible to test signals on power conductors.

CS06 Testing configuration(s): Operating on copper test bench.
Performance (pass/fail): Pass
Comments: Not susceptible to test spikes

Radiated Emissions Tests:

RE02 Testing configuration(s): Operating on wooden test stand in the EMC chamber.
Performance (pass/fail): Pass.
Comments: No emissions in excess of limits were detected.

Radiated Susceptibility Tests:

RS03 Testing configuration(s): Operating on the wooden test stand in the EMC chamber.
Performance (pass/fail): Fail.

Comments:

ac Operation -	
Frequency	Field strength
30.0 - 189.8 MHz	1.0 - 8.41 V/m
dc Operation -	
7.6 - 204 MHz	0.33 - 6.31 V/m
Battery Operation -	
30.0 - 204 MHz	1.41 - 8.41 V/m

3.3 CRITERIA, SIGNIFICANT PROBLEMS, AND SUGGESTED IMPROVEMENTS

3.3.1 Criteria

Item No.	Criteria (source)	Remarks	Applicable subparagraph
1	The physical inventory is conducted solely for investigation and documentation.	NA	2.1.2.1
2	The ALSS 20-H will perform consistently and accurately.	met	2.1.2.2
3	Verify manufacturer's specified full power internal battery life expectancy of 3 hours.	met	2.2.2
4	The ALSS 20-H will meet the limits established in NFPA 99 for electrical safety of medical equipment.	met	2.3.2
5	The ALSS 20-H will be rated satisfactory in all major categories of the evaluation. These include: Visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.	met	2.4.2
6	The ALSS 20-H will demonstrate proper operation while exposed to an altitude equivalency of 15,000 feet above sea level.	met	2.5.2
7	The ALSS 20-H will remain operational while exposed to vibrational stresses.	met	2.6.2
8	The ALSS 20-H will remain operational during the high temperature operation check.	partially met	2.7.2.1

9	The ALSS 20-H will remain operational after the high temperature storage.	met	2.7.2.2
10	The ALSS 20-H will remain operational during the low temperature operation check.	partially met	2.8.2.1
11	The ALSS 20-H will remain operational after the low temperature storage.	met	2.8.2.2
12	The ALSS 20-H will remain operational while exposed to a high humidity.	met	2.9.2
13	The ALSS 20-H will not produce emissions in excess of the limits set forth in MIL-STD-461A Notice 4, paragraph 6.13.	partially met	2.10.2.1
14	The ALSS 20-H will not malfunction when it is subjected to radiated fields as specified in MIL-STD-461A, Notice 4, paragraph 6.20.	partially met	2.10.2.2
15	The ALSS 20-H produced conducted emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraph 6.2.	partially met	2.10.2.3
16	The ALSS 20-H will not malfunction when it is subjected to test generated signals as specified in MIL-STD-461A, Notice 4, paragraphs 6.7 and 6.10.	met	2.10.2.4
17	The flight surgeon will be able to operate the ALSS 20-H without physical or functional restrictions aboard the aircraft.	met	2.11.2.1

18	The ALSS 20-H will not radiate EMI to disrupt or interfere with the other equipment or systems aboard the aircraft.	met	2.12.2.2
19	The aircraft will not radiate EMI to disrupt or interfere with the ALSS 20-H.	met	2.12.2.3

3.3.2 Significant problems which require corrective action

None

3.3.3 Suggested improvements

None

3.4 REFERENCES

3.4.1 Department of Defense. 1971. EMI characteristics, requirements for equipment. Washington, DC. MIL-STD-461A, Notice 4. February.

3.4.2 Department of Defense. 1971. EMI characteristics, measurement of. Washington, DC. MIL-STD-462, Notice 3. February.

3.4.3 Department of Defense. 1983. Environmental test methods and engineering guidelines. Washington, DC. MIL-STD-810D. July.

3.4.4 Department of the Army. 1987. Maintenance management procedures for medical equipment. Washington, DC. TB 38-750-2. April.

3.4.5 Underwriters Laboratory's, Inc. 1978. Standard for safety, medical and dental equipment. Chicago, Illinois. UL-544.

3.4.6 Department of Defense. 1989. Human engineering design criteria for military systems, equipment, and facilities. Washington, DC. MIL-STD-1472D. March.

3.4.7 Association for the Advancement of Medical Instruments. 1988. Human factors engineering guidelines and preferred practices for the design of medical devices. Arlington, Virginia. AAMI-HE-1988. February.

3.4.8 National Fire Protection Association. 1987. Standard for health care facilities. Quincy, Massachusetts. NFPA 99. February.

3.4.9 Department of the Army. 1982. Environmental protection and enhancement. Washington, DC. AR 200-1. June.

3.5 ABBREVIATIONS

ac	alternate current
ALSS	Airborne Life Support Systems
AVSCOM	Army Aviation Systems Command
AWR	airworthiness release
BB	broadband
CAAF	Cairns Army Airfield
dc	direct current
EMC	electromagnetic compatibility
EMI	electromagnetic interference
fpm	feet per minute
GFE	government furnished equipment
Gpk	gravity, peak
G(rms)	gravity (root mean square)
Hz	hertz
IAW	in accordance with
ITOP	in-flight test operating procedure
IV	intravenous
kHz	kilohertz
LCD	liquid crystal display
LED	light emitting diode
LISN	line impedance stabilization network
MEDEVAC	medical evacuation
MHz	megahertz
MIL-STD	military standard
mL	milliliter
mm	millimeter
mmHg	millimeters of mercury
MSL	mean sea level
NFPA	National Fire Prevention Association
NB	narrowband
NBC	nuclear, biological and chemical
NOE	nap-of-the-earth
NVG	night vision goggle
RF	radio frequency
RFI	radio frequency interference
RH	relative humidity

TB	technical bulletin
TFT	technical feasibility testing
T & E	test and evaluation
UES	Universal Energy Systems, Inc.
USAARL	U.S. Army Aeromedical Research Laboratory
Vac	volts alternating current
V/m	volts per meter

3.6 LIST OF MANUFACTURERS

3.6.1 Airborne Life Support Systems
7651 Airport Boulevard
Houston, TX 77061

3.6.2 Neurodyne-Dempsey, Inc.
200 Arrowhead Drive
Carson City, NV 89701

3.6.3 Tenney Engineering, Inc.
1090 Springfield Road
P.O. Box 3142
Union, NJ 07083

3.6.4 Unholtz-Dickey Corporation
6 Brookside Drive
Wallingford, CT 06492

3.6.5 Solar Electronics Company
901 North Highland Avenue
Hollywood, CA 90038

3.6.6 Tektronix, Inc.
P.O. Box 500
Beaverton, OR 97077

3.7 DISTRIBUTION LIST

Commander, U.S. Army Natick Research,
Development and Engineering Center
ATTN: SATNC-MIL (Documents
Librarian)
Natick, MA 01760-5040

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Command
ATTN: AMSEL-RD-ESA-D
Fort Monmouth, NJ 07703

Commander/Director
U.S. Army Combat Surveillance
and Target Acquisition Lab
ATTN: DELCS-D
Fort Monmouth, NJ 07703-5304

Commander
10th Medical Laboratory
ATTN: Audiologist
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Naval Air Development Center
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Warminster, PA 18974

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National Naval Medical Center
Bethesda, MD 20814-5044

Deputy Director, Defense Research
and Engineering
ATTN: Military Assistant
for Medical and Life Sciences
Washington, DC 20301-3080

Commander, U.S. Army Research
Institute of Environmental Medicine
Natick, MA 01760

Library
Naval Submarine Medical Research Lab
Box 900, Naval Sub Base
Groton, CT 06349-5900

Director, U.S. Army Human
Engineering Laboratory
ATTN: Technical Library
Aberdeen Proving Ground, MD 21005

Commander
Man-Machine Integration System
Code 602
Naval Air Development Center
Warminster, PA 18974

Commander
Naval Air Development Center
ATTN: Code 602-B (Mr. Brindle)
Warminster, PA 18974

Commanding Officer
Armstrong Laboratory
Wright-Patterson
Air Force Base, OH 45433-6573

Director
Army Audiology and Speech Center
Walter Reed Army Medical Center
Washington, DC 20307-5001

Commander, U.S. Army Institute
of Dental Research
ATTN: Jean A. Setterstrom, Ph. D.
Walter Reed Army Medical Center
Washington, DC 20307-5300

Naval Air Systems Command
Technical Air Library 950D
Room 278, Jefferson Plaza II
Department of the Navy
Washington, DC 20361

Commander, U.S. Army Test
and Evaluation Command
ATTN: AMSTE-AD-H
Aberdeen Proving Ground, MD 21005

Director
U.S. Army Ballistic
Research Laboratory
ATTN: DRXBR-OD-ST Tech Reports
Aberdeen Proving Ground, MD 21005

Commander
U.S. Army Medical Research
Institute of Chemical Defense
ATTN: SGRD-UV-AO
Aberdeen Proving Ground,
MD 21010-5425

Commander, U.S. Army Medical
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Falls Church, VA 22041-3258

Harry Diamond Laboratories
ATTN: Technical Information Branch
2800 Powder Mill Road
Adelphi, MD 20783-1197

U.S. Army Materiel Systems
Analysis Agency
ATTN: AMXSY-PA (Reports Processing)
Aberdeen Proving Ground
MD 21005-5071

U.S. Army Ordnance Center
and School Library
Simpson Hall, Building 3071
Aberdeen Proving Ground, MD 21005

U.S. Army Environmental
Hygiene Agency
Building E2100
Aberdeen Proving Ground, MD 21010

Technical Library Chemical Research
and Development Center
Aberdeen Proving Ground, MD
21010-5423

Commander
U.S. Army Medical Research
Institute of Infectious Disease
SGRD-UIZ-C
Fort Detrick, Frederick, MD 21702

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Sciences Division
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600 North Quincy Street
Arlington, VA 22217

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U.S. Army Materiel Command
ATTN: AMCDE-XS
5001 Eisenhower Avenue
Alexandria, VA 22333

Commandant
U.S. Army Aviation
Logistics School ATTN: ATSQ-TDN
Fort Eustis, VA 23604

Headquarters (ATMD)
U.S. Army Training
and Doctrine Command
ATTN: ATBO-M
Fort Monroe, VA 23651

Structures Laboratory Library
USARTL-AVSCOM
NASA Langley Research Center
Mail Stop 266
Hampton, VA 23665

Naval Aerospace Medical
Institute Library
Building 1953, Code 03L
Pensacola, FL 32508-5600

Command Surgeon
HQ USCENTCOM (CCSG)
U.S. Central Command
MacDill Air Force Base FL 33608

Air University Library
(AUL/LSE)
Maxwell Air Fore Base, AL 36112

U.S. Air Force Institute
of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson
Air Force Base, OH 45433

Henry L. Taylor
Director, Institute of Aviation
University of Illinois-Willard Airport
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Chief, Nation Guard Bureau
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Federal Aviation Administration
Civil Aeromedical Institute
Library AAM-400A
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Oklahoma City, OK 73125

Commander
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